WHAT? *Why?* WHEN? HOW? WHERE? WHO?

THE MASTODON

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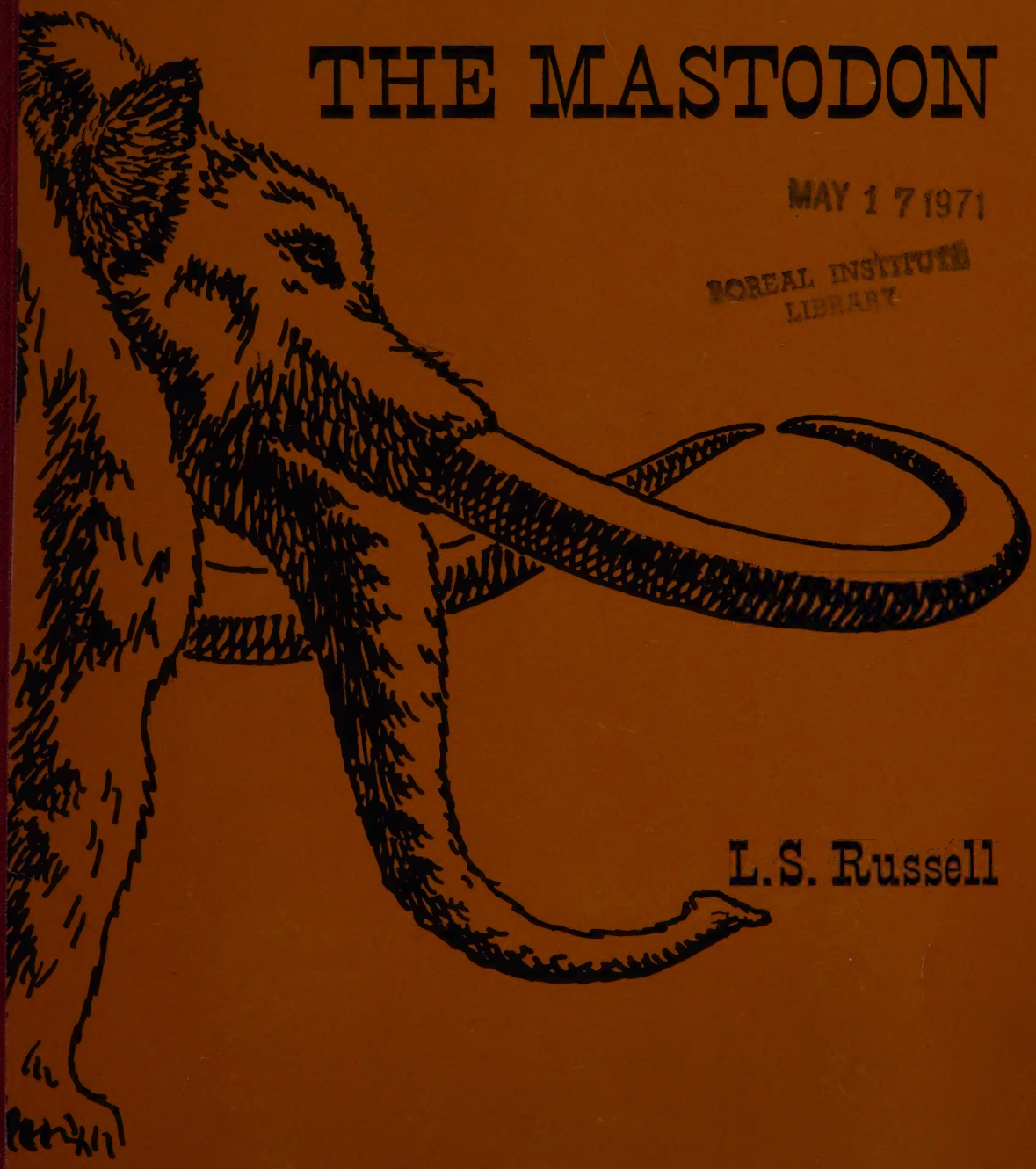

L. S. Russell

Royal Ontario Museum / University of Toronto

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I keep six honest serving-men

(They taught me all I knew);

Their names are WHAT *and* WHY *and* WHEN

And HOW *and* WHERE *and* WHO. RUDYARD KIPLING

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WHAT? HOW? *Why?* WHERE? WHEN? WHO?

The Mastodon

by L. S. RUSSELL

WHO discovered the mastodon?

There are many animals that are characteristic of Canada, such as the beaver, moose, caribou, and porcupine. If we were making a list of those most uncharacteristic of this country, the elephant might well come first. Yet a few thousand years ago animals that looked like elephants lived in what is now Canada, from Nova Scotia to the Yukon. These were the mastodons.

The earliest Indians on this continent must have known the mastodon as a living animal, but if so, their descendants had forgotten completely. It remained for European explorers to reveal its former presence. In 1739 an expedition from Montreal under the leadership of Charles Le Moyne, Baron de Longueuil, journeyed down the Ohio River towards the Mississippi and along the way found bones and teeth that we now know belonged to the mastodon. But to the early discoverers, and even to the naturalists to whom they submitted their finds, the nature of this gigantic beast was a mystery. Many believed that it was a great beast of prey, and some assumed that such a creature was still living in the wilds of America.

It was the great French anatomist, Georges, Baron Cuvier, who first

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interpreted the mastodon fossils correctly. In 1799 he showed that the bones of the skeleton were essentially the same as those of the elephant but that the teeth were very different, and later he coined the name *mastodon* ("nipple-tooth") in allusion to the shape of their paired cusps (see p. 12). Cuvier also showed that there were several different kinds of mastodons, some of them in Europe, but that the biggest was "Le grand mastodonte de l'Ohio".

During the 19th century many more mastodon teeth and bones were found in the Ohio valley, particularly at the famous Big Bone Lick in Kentucky. Moreover, nearly complete skeletons were obtained from the Hudson River valley in upper New York State, even including samples of hair and stomach contents. Assembled in approximately their natural arrangement, these skeletons made it obvious that the mastodon was really a sort of elephant, though many people still clung to the belief that it was a giant carnivore.

WHERE have they been found in Ontario?

The earliest dated discovery of mastodon remains in Canada was in 1834, when a thigh bone was found in Victoria County, Cape Breton, Nova Scotia. A typical mastodon tooth was discovered in the same area in 1859. Meanwhile, mastodon fossils were being found in Upper Canada: the first on record was a tooth uncovered in Elgin County in 1858. Since then many additional specimens have been found, the greatest concentration of sites being along the north shore of Lake Erie.

Of these finds, the best is an incomplete skeleton from near Welland, discovered in 1912 and now mounted in the Royal Ontario Museum. It evidently represents a mature male. When it was found the limb bones and some other parts had been destroyed or carried away by erosion. At first the skeleton was displayed in the Museum with no attempt to represent the missing parts—until visitors were heard to comment how curious it was that so large an animal should have no legs! In 1933, when the entire fossil collection was moved to new galleries, plaster casts representing the missing bones were obtained from the American Museum of Natural History. They were based on a skeleton found by J. C. Warren in 1845 near Newburgh, N.Y., probably the only complete specimen ever uncovered.

Another interesting find of mastodon bones was made in 1947 near Rodney, Ontario. In trying to locate a lost tile drain, a farmer discovered a pair of medium-sized tusks. The site was excavated by a group from the Royal Ontario Museum, and although only a small part of the skeleton was found, this included the two lower tusks, to be described later. The most

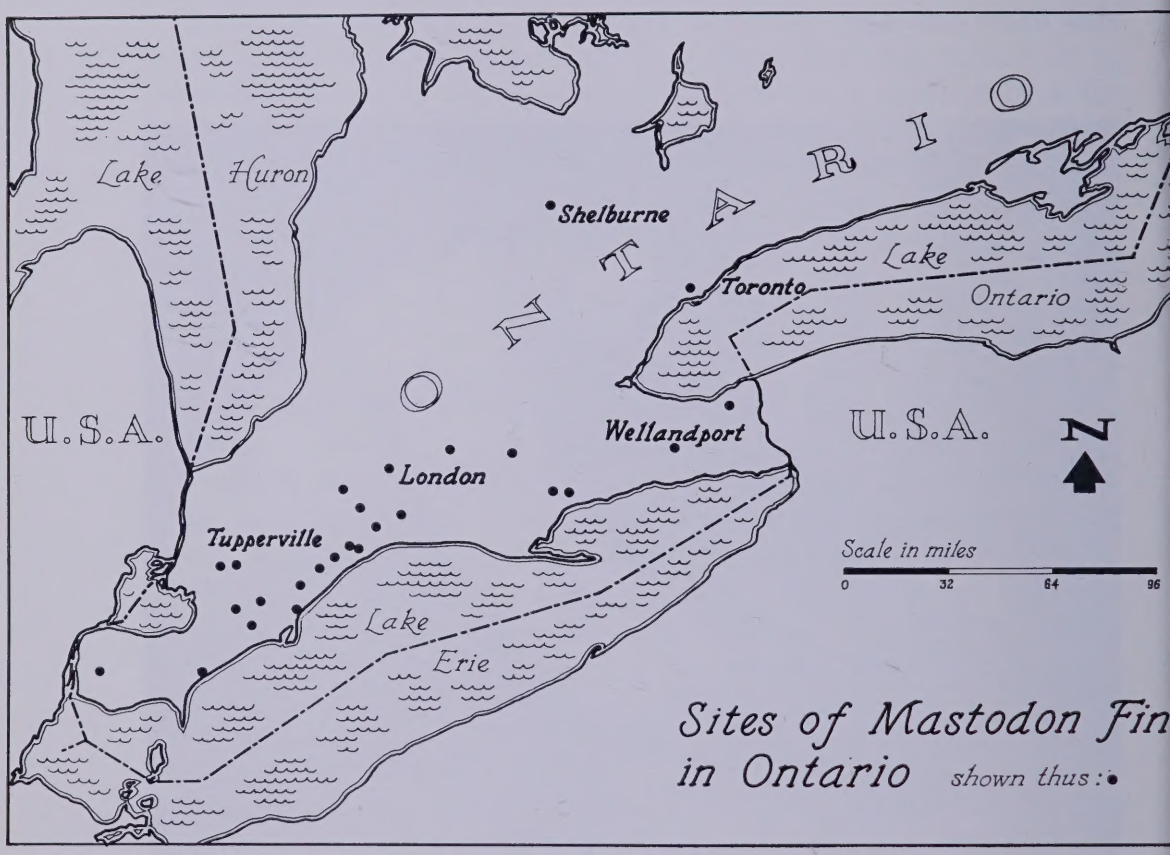
important aspect of the Rodney find was, however, that the bones were preserved in a black, highly carbonaceous muck. Carbon-14 analyses of the muck and of pieces of wood found within it showed that the deposit had been laid down more than 11,000 years ago.

A much more recent datable skeleton was excavated in 1956 near Tupperville, Ontario, by geologists from the University of Western Ontario. Organic material with these bones gave a radio-carbon date of a little more than 6,000 years ago.

The top of a mastodon's skull is uncovered by ROM *experts near Wellandport, Ontario. This is a skilled job, if the specimen is to be kept in good shape. If you should find mastodon bones, don't try to dig them up yourself: call the nearest museum for help.*

Another find of significance was made in 1963, near Wellandport, Ontario. Here a scattered skeleton had been uncovered and partly destroyed in excavating a bog. Like the Rodney specimen, the Wellandport material includes two medium-sized tusks, and is thought to represent a female. The bones and teeth are preserved in the Royal Ontario Museum.

Undoubtedly, many mastodon skeletons or parts of skeletons still lie buried in southwestern Ontario, and any low, boggy spot along the north shore of Lake Erie is a potential site. Elsewhere in Ontario mastodon remains seem to be less numerous, although finds have been made at Toronto, Hamilton, and St. Catharines.



In the Yukon Territory, mastodon bones and teeth have been found in the frozen sands and gravels that have been sluiced down and washed for their gold content. Other kinds of mammals are also represented here by bones, including the mammoth, a true elephant. The Yukon deposits are probably much older than those yielding mastodon bones in Ontario, for in spite of its far northerly position the western part of Yukon Territory was not overrun by the continental glaciers. Thus deposits dating from early in the Ice Age could have been preserved, instead of being destroyed by later advances of the ice.

In addition to those in the ROM, mastodon specimens may be seen in the National Museum of Canada at Ottawa.

WHAT did the mastodon look like?

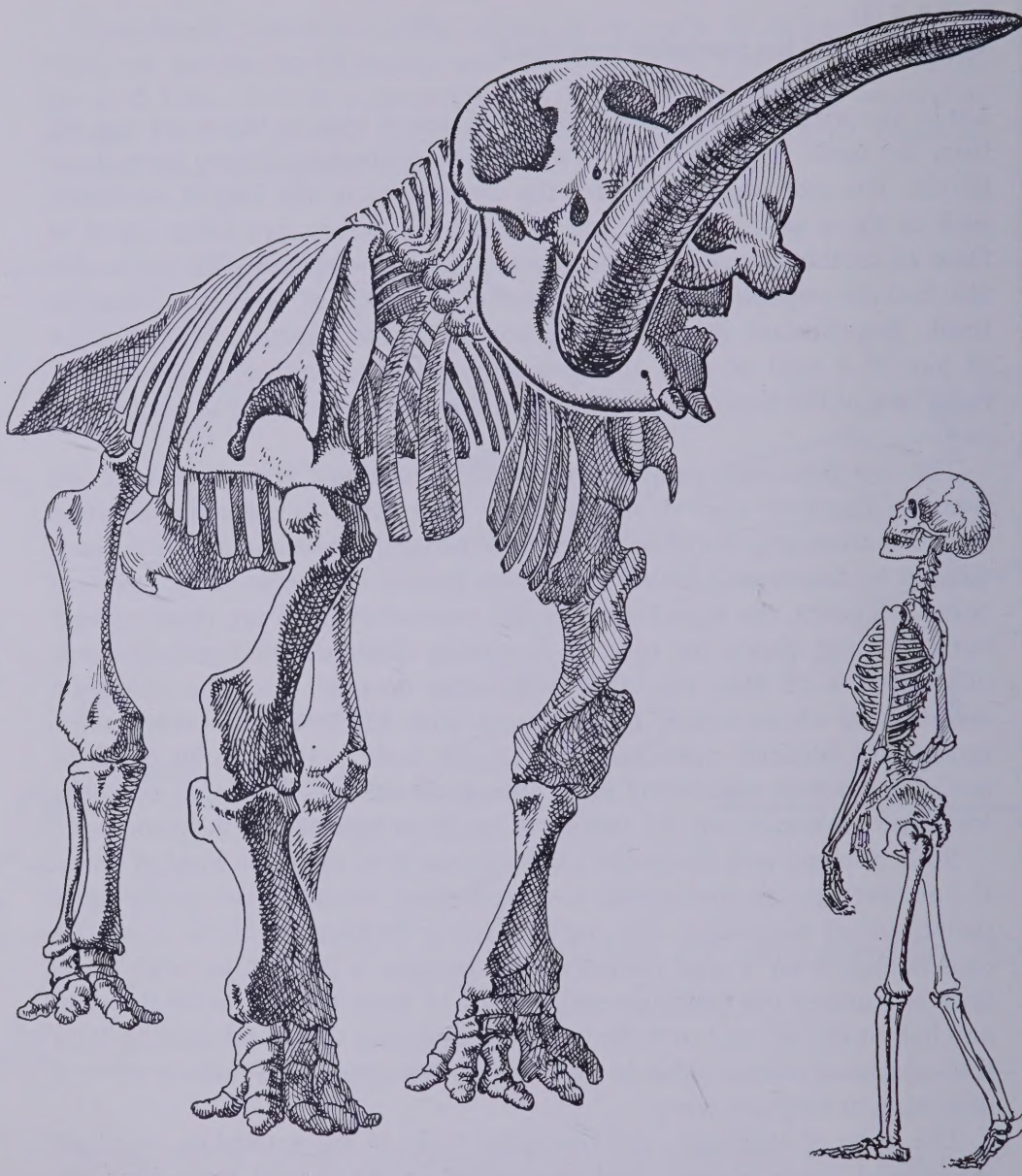
Let us see what kind of an animal the mastodon was, as far as we can tell from the fossil remains. That it was elephant-like has already been mentioned. The size was similar, for the dimensions of the largest skeletons, such as those of the Warren and Welland mastodons, are about equal to those of Jumbo, one of the largest known African elephants. The mastodon also had the elephant's two most characteristic features, tusks and a flexible trunk. Nevertheless, it is evident he was not a true elephant. We can think of him as a kind of poor relation, getting along, making pretensions of being one of the family, but never quite discarding the traces of his humble origin.

The two tusks that projected from the mastodon's upper jaw were the same as those of true elephants. Now their ivory is stained and often shattered from long burial in the earth. When only the tusks are found, it is difficult to determine whether they come from a mastodon or the contemporary elephant, the mammoth. Usually mammoth tusks are more curved, but this is not always the case. In mastodon skulls we frequently find one tusk more worn than the other, suggesting unequal use. This condition seems to be characteristic of specimens with big tusks, probably males. Indeed, the Welland mastodon had only one tusk: perhaps in his youth he used his left tusk excessively until damage to the root led to its complete loss. This asymmetry of the tusks has not been reported in the mammoth.

Both elephant and mastodon tusks are made of the same kind of ivory. If you were to cut and polish a cross-section of tusk, you would see a pattern which machinists call engine-turning. Perhaps you have seen it as ornamentation on a gold pocket-watch. Imagine a circle filled with spiral lines all curving out from the centre. Half of these lines curve to the right and half to the left. All over the circle the opposing spirals intersect to form little diamond shapes. This is the pattern that appears in end-on view of mastodon or elephant ivory.

The tusks of elephants, and the upper tusks of the mastodon, represent the second upper incisors, and correspond to the second teeth from the middle in the upper jaw of man. When fossil tusks are found in the earth they are usually saturated with water. As the ivory dries it contracts and splits, and a good specimen may be quickly ruined. If you should ever discover the tusks or teeth of a mastodon or mammoth, be sure to keep them moist, either with damp cloths or wet earth, until an experienced museum collector can take over.

The most distinctive portion of the mastodon skeleton is the cheek tooth, as distinct from the tusks. The mastodon had a total of 24 such teeth during its lifetime, six on each side above and below, but there were never

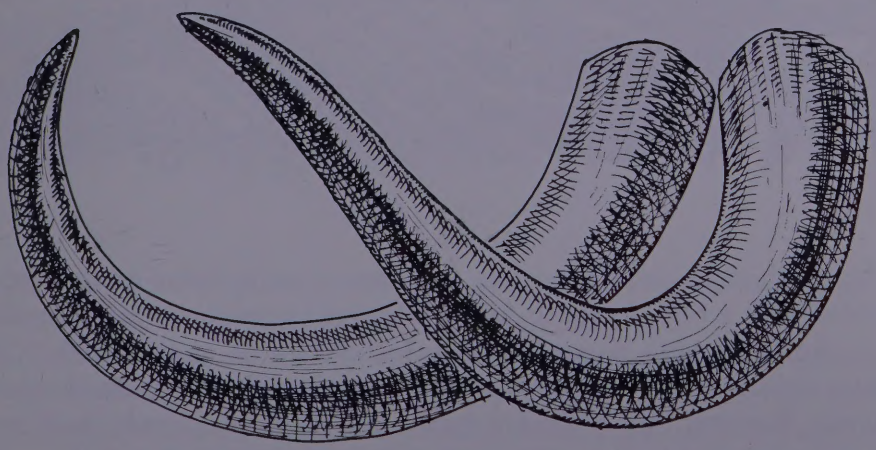


Mastodon skeleton in the Royal Ontario Museum evidently belonged to a mature male animal. It was found with only one tusk: the other seems to have been lost early in life, for the left socket is much too small to hold another full-sized tusk. The human skeleton drawn beside it is that of a grown man.

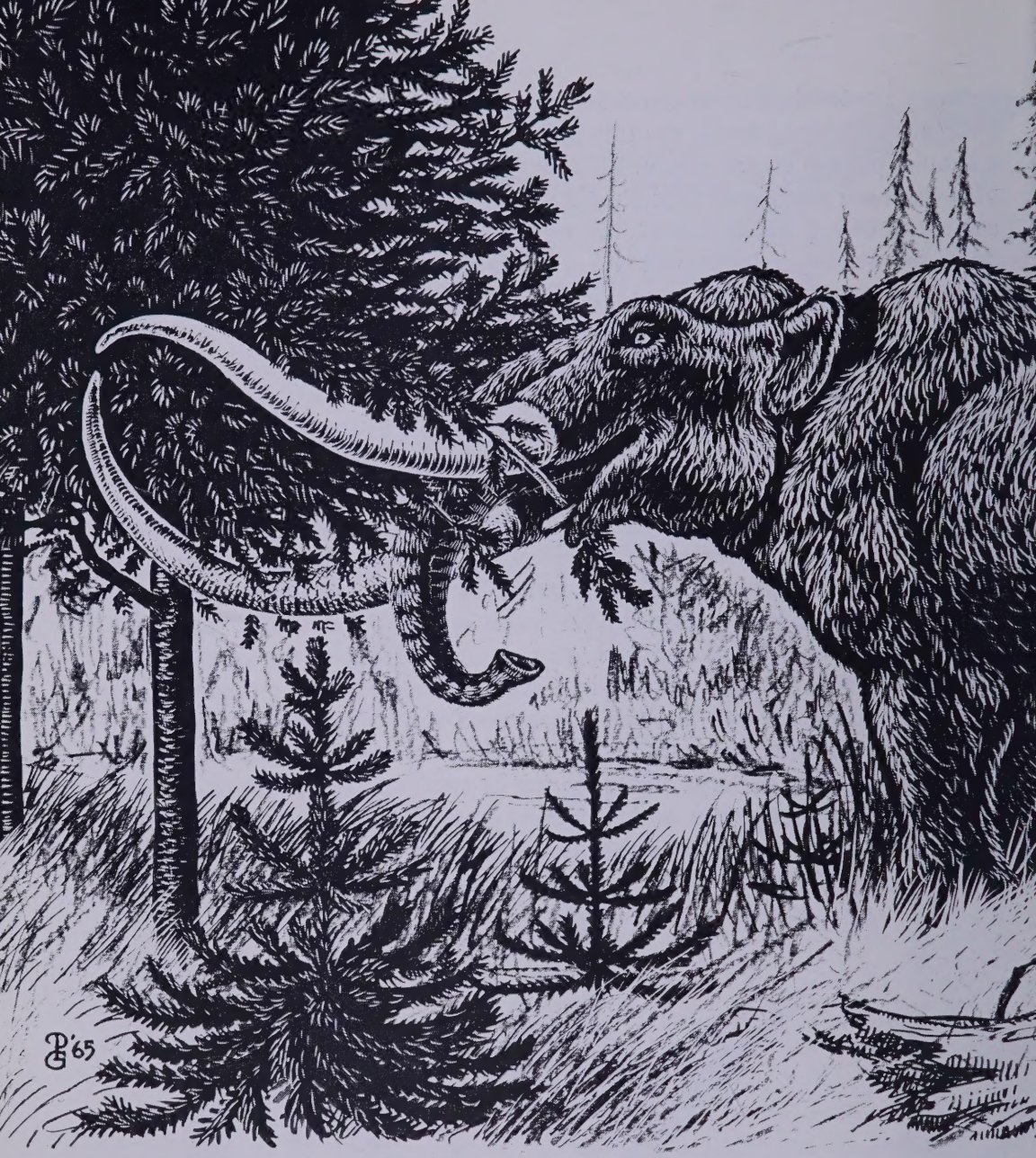
more than four of these present at one time, and usually only three. This may seem a small number of teeth, but true elephants have only one tooth at a time, or at most two, on each side above and below. A typical mastodon tooth is shown on page 12: it is the rear molar of the lower jaw. Big by any

ordinary standards, it is smaller than the corresponding tooth of an elephant. Unlike the elephant tooth, the mastodon tooth has well defined roots, and a simpler pattern on the crown. This pattern is made up of two to six pairs of cusps, each pair joined across the tooth by a transverse crest. There is no cement covering the crown of the tooth, and when the crests are worn down by use they become oval "lakes". The rim of these "lakes" is formed by the worn edge of the surface enamel, and the inner part by the exposed internal substance of the tooth, the dentine.

Contrast this with the structure of an elephant tooth, such as the mammoth molar shown below it. Here we see a massive object, with only a trace of distinct roots. Instead of the low transverse crests of the mastodon tooth, there is a large series of plates, pressed closely together. Each plate has enamel on the front, back and edges, with the interior formed of dentine. The thin spaces between plates are filled with a superficial deposit known as cement. Thus the apparently solid tooth is made up of alternating layers of three different materials, the hardest being the enamel, and the softest the cement. Wear on such a tooth may remove material, but always leaves a rough surface because of the three degrees of hardness of the constituent substances. The elephant's tooth is a most efficient grinding organ, and makes it possible for him to chew coarse foods such as grass and hay. The mastodon tooth indicates a softer kind of food, such as the leaves of trees. Elephant teeth are so large that only one or two can be present on either side of the jaw at one time, and they must grow into position from behind. The smaller, more normal teeth of the mastodon could grow in from above or below, and there was space in the jaw for as many as four on each side.



Mastodon tusks are almost exactly the same as those of modern elephants.

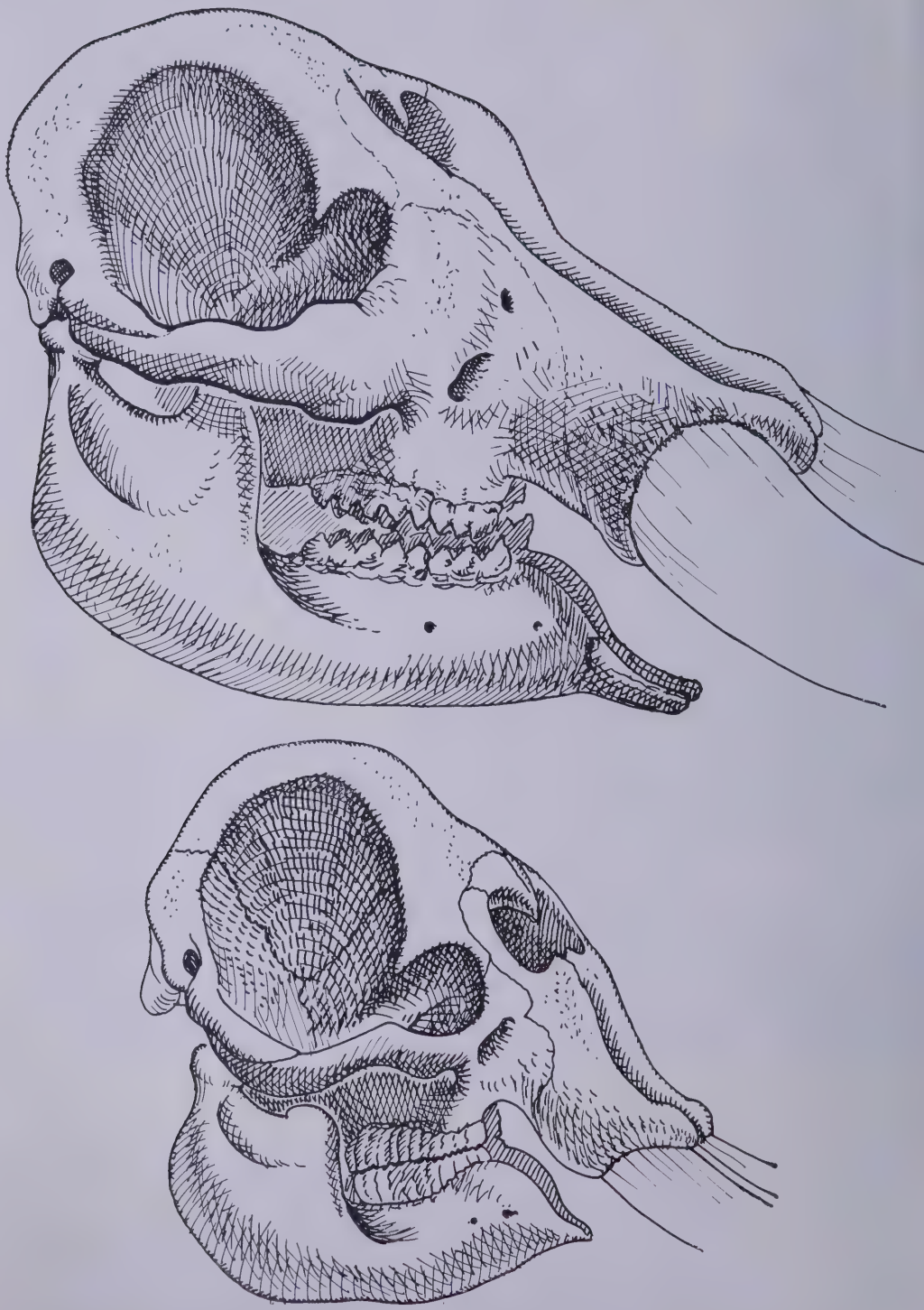


The skull of the mastodon has the same general form as that of the elephant, with a high forehead for attachment of trunk and neck muscles, and a shortened nose region to allow for movement of the trunk. These features are less extremely developed in the mastodon than in the elephants. Certainly, however, the mastodon had a well developed trunk, used in the same way as that of living elephants, for all the features in the elephant skull associated with the trunk are also present in the mastodon. The high forehead of both animals is not a sign of intellectual power; much of the height

Mastodons roamed evergreen forests in southwestern Ontario as recently as about 6,000 years ago. By that time in Palestine, the walls of Jericho were already built. Artist's reconstruction of a mastodon is based on skeletons and traces of hair that have been uncovered.

is accounted for by spaces within the bony roof of the skull. Again the elephants exceed the mastodon in this development.

In the remainder of the skeleton there are few important differences between elephants and mastodon. Both have short necks, flaring shoulder blades and hip bones, and massive vertical limbs. Like the living elephants, the mastodon had five toes on each foot, and the arrangement is so similar as to indicate that these toes, like those of the elephants, were enclosed in a common fleshy mass, supported beneath by a cushion of elastic tissue.

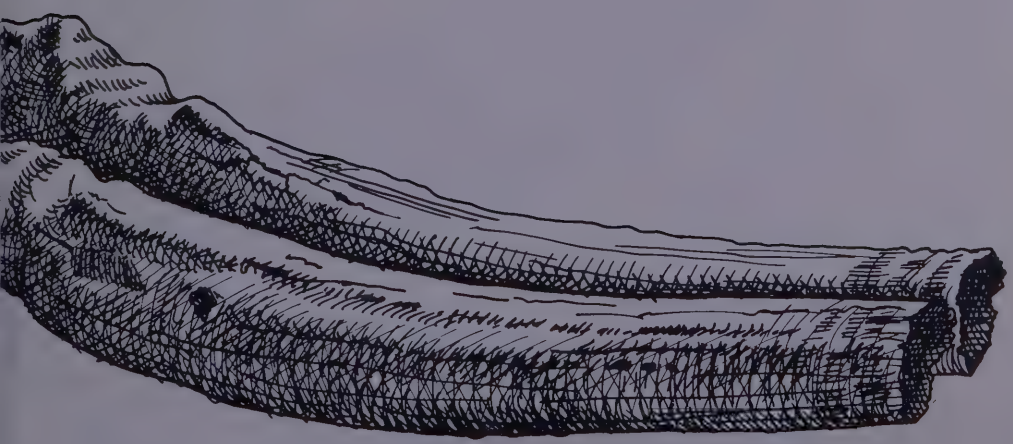


While there are distinct differences between a mastodon skull (top) and an elephant skull (bottom), they are in general so much the same that we can be quite certain the mastodon had a trunk very like the elephant's.

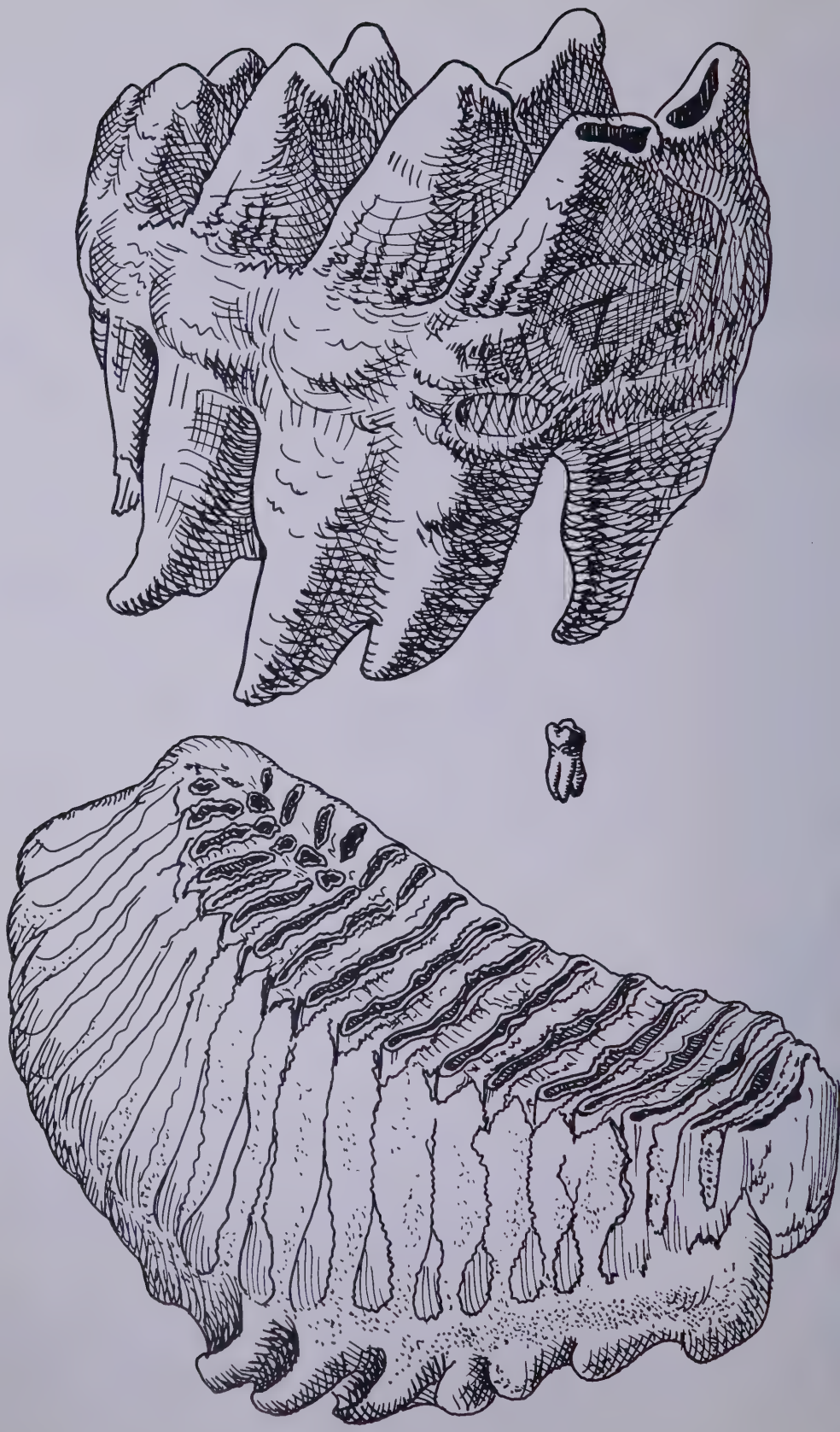
The footprint of an elephant is like a shallow post hole, and no doubt the mastodon's was similar. Living elephants are almost hairless, but with some fossil mastodons traces of hair have been found. This hair is coarse and twisted, two inches or more in length, and brown in colour. There was no woolly undercoat, such as has been found on the hides of frozen mammoth carcasses. With the Warren mastodon traces of the stomach contents were found, consisting mainly of the tender twigs of coniferous trees.

HOW **were its lower tusks used?**

Along with upper tusks almost identical with those of elephants, the mastodon also had lower tusks, which no true elephant has. These lower tusks were shaped like a poorly rounded bar, slightly curved. They varied in length from about seven inches to nearly two feet. Only a small portion of them projected from the jaw bone in the vicinity of the chin, and even this was probably concealed by hair. It has been said that they occurred only in male mastodons, and even then only as a single tusk. The mastodon remains found near Rodney are, however, believed to be those of a female, because of the small and uniform size of the tusks associated with teeth of adult size; yet with these remains were found two lower tusks, obviously the right and left of one individual. In the illustration on this page, they are shown in the position they once occupied side-by-side in the jaw. Notice



The mastodon's lower tusks are something of a mystery. No true elephant has them. These specimens were only seven inches long; they could barely have been visible when the animal's mouth was closed. In this booklet the author suggests for the first time in print how they may have been used.



(on the left) the short worn portion that projected from the jaw, and the much longer, unworn part that lay within the socket. Wear has produced deep grooves cutting across the tusks in the vicinity of the gum line. Such grooves have been seen in other lower tusks. It is the writer's theory that the lower tusks were used to strip leaves and twigs, which the mastodon ate, from the branches on which they grew. The mastodon would draw the branch through its mouth, holding it against its lower tusks with its tongue. As the foliage was stripped off, the rough stems would wear away the ivory across the tusks.

There is another interesting point about the lower tusks. The common ancestors of the mastodon and the elephants had well developed lower tusks, which were used in some cases for root-grubbing. With the increase in importance of the trunk, the lower tusks became reduced, and in the ancestry of the true elephants were eventually lost. The mastodons retained them in reduced form, and still managed to find use for them.

WHEN **did mastodons live?**

Mastodon-like animals existed in North America in the middle of the Miocene epoch, that is, about 25 million years ago. But the type of animal we are discussing did not appear on this continent until about one million years ago, early in the Pleistocene epoch or Ice Age. It is not definitely known whether it developed from the mastodon-like creatures already here, or whether it came from Asia via the land bridge which then spanned the Bering Strait. We do know, however, that the mastodon survived the rigours of the Ice Age.

At least four times the great glaciers spread out from the Hudson Bay region, covering most of what is now Canada, and extending far into the area of the north-central United States. With each advance of the ice the climatic zones were pushed southward, and with them went the plants and animals characteristic of each zone. The mastodon evidently belonged to the cool temperate forest zone, in an environment not unlike that favoured today by the moose and woodland caribou. Hence during the maximum

astodon tooth (top) is about seven inches long. Note the paired cusps give the animal its name (Greek for "nipple tooth"). In contrast the oth tooth (below), which is typical of all true elephant teeth, has a series ely-spaced plates. The tiny tooth between them is a human molar drawn same scale.

stages of glacial advance the home of the mastodon was just south of the ice, extending from the Yukon to New Jersey. During the warm interglacial ages the ice melted back, and the climatic zones moved northward again. The mastodon, with other cool-zone animals, thus moved southward and northward with each successive advance and melting back of the glaciers.

In those areas over which the ice advanced a number of times, the sand and clay deposits, with their enclosed fossil records of interglacial time, were usually destroyed by subsequent glacial erosion. Only in rare cases, as in the Don Valley and the Scarborough Cliffs of the Toronto district, were the interglacial deposits spared. Yet throughout southwestern Ontario, mastodon fossils have been found in shallow swamp deposits. This indicates that the mastodon survived after the last melting back of the ice, for surely any subsequent glacial advance would have destroyed these shallow burials.

The final melting back of the continental glaciers is believed to have begun about 35,000 years ago. As the ice front withdrew, more and more of the Great Lakes and the St. Lawrence drainage system was exposed. A detailed and interesting series of events has been worked out, too lengthy to be described here, but fully presented in some of the references listed on page 16. During this time of melting glaciers and changing drainage, the mastodon last occupied what is now southern Ontario. Correlation of the physical events with radio-carbon datings suggests that this period extended from about 20,000 to about 6,000 years ago. Long before it ended, the ancestors of our North American Indians had come to this continent, and had set up camps along the shores of the Great Lakes. Man and mastodon, therefore, must have lived together in this region for at least one or two thousand years.

Why did the mastodon disappear?

Man may have speeded the process by hunting the mastodon, but at present this is only conjecture: we have yet to find a mastodon skull with an embedded projectile point, or a mastodon bone that has been artificially fractured or charred. What else, then, might have been responsible for the extermination of beasts big enough and strong enough to be safe against most natural enemies? It must have been a combination of factors, of which changing climate and vegetation were very important.

We can visualize post-glacial southern Ontario as a region of cool but very moist climate, with extensive bogs, and coniferous forests. These apparently were ideal conditions for the mastodon. As time went on the climate became warmer and drier, the swamp-lands more restricted, and

the forests changed to consist predominantly of deciduous trees. One would expect that the mastodon would have followed the boreal forests northward, and in fact there are some records of remains from northern Ontario. But the rocky wastes of the Canadian Shield are very different from the fertile flat-lands of southern Ontario, and the mastodon does not seem to have been able to adapt itself to the more northern habitat. We have seen many instances in modern times of a species being reduced in population to a critically low level, at which point the lesser agents of destruction, once unimportant, may become decisive. This was the history of the passenger pigeon, and almost the fate of the plains bison, and today the whooping crane is trembling on the brink of oblivion, with trivial accidents likely to give the final push. The breaking up of what had been the ideal combination of natural conditions for the mastodon may have reduced its once continuous population to isolated groups, whose existence could be jeopardized by short-term climatic changes or the depredations of man.

This is all speculation, and we may never be sure of the reasons why the mastodon, once a most characteristic animal of our region, is now known only from bones and teeth in ancient bog deposits. But in a way we can bring him back to life, by anatomical study, by museum exhibits, and by the scientifically controlled imagination of the artist.

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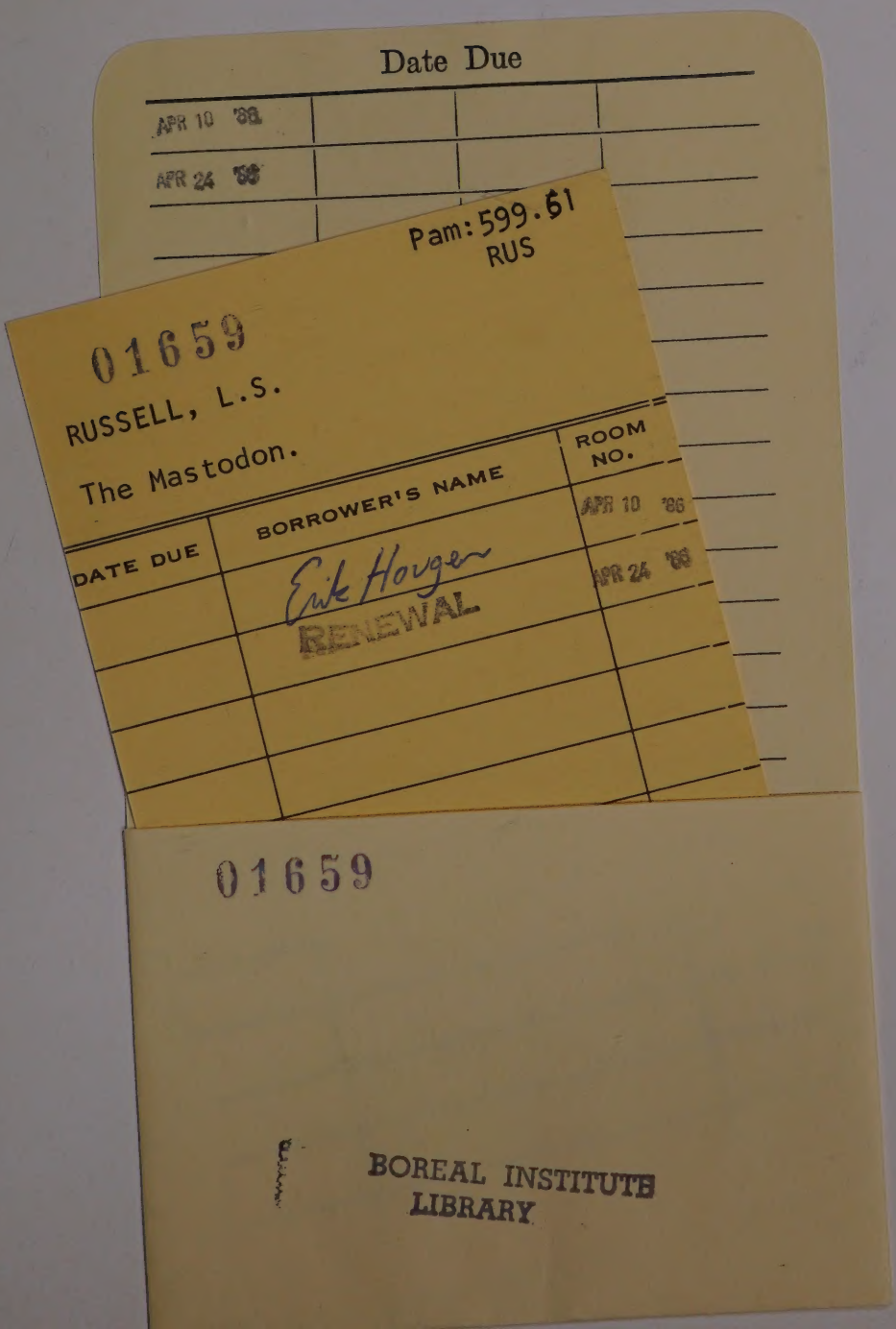

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